CHAPTER 2
METHODS AND THEORIES IN SPORTS ECONOMICS

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2.1 INTRODUCTION

This chapter briefly summarizes the most common theories and empirical methods discussed within sports economics. The theories surveyed relate to professional team sports and comprise profit-maximizing models, win-maximizing models and behavioural economics as a newer approach. The empirical methods considered relate to individual and team sports and sports participation. These are divided into the contingent valuation method (CVM) for policy interventions, regression analysis applied to sports participation and natural experiments using difference-in-difference methodology. Various academic articles are used to selectively exhibit these themes.

2.2 THEORIES

In line with other businesses, sports teams might be assumed to maximize profits, defined as revenue minus costs. Revenues of sports teams typically comprise gate receipts, income from sales of broadcast rights and commercial revenues such as sales of replica shirts. A convenient assumption is that revenues from broadcast income and commercial income sources are a constant multiplier of gate receipts, although this assumption breaks down if crowds are absent from stadia, as in the period of the Covid-19 pandemic. Leaving aside Covid-19 restrictions, this assumption means analysis can proceed by focusing on gate attendance and gate revenues.

2.2.1 Profit-maximizing models of team sports

The profit-maximizing approach to a model of a professional sports league starts with the attendance demand function for team *i*:

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$$A_i = f(p_i, w_i, w_i^2, m_i) \quad (1.1)$$

where A_i is attendance, p_i is a uniform ticket price, w_i represents team wins and m_i denotes market size.

This function then maps into a revenue function:

$$R_i = f(p_i, w_i, w_i^2, m_i) \quad (1.2)$$

Wins are determined by amounts of player talent, t_i, an inherently abstract and unmeasurable concept but important for analysis. Wins and talents are related through a contest success function:

$$w_i = t_i/(t_i + t_j) \quad (1.3)$$

where t_j denotes the talent of all other teams.

Then team i's revenue function can be expressed in terms of talents:

$$R_i = g(p_i, t_i, t_i^2, t_j, m_i) \quad (1.4)$$

Any team faces a competitively determined unit cost of talent, c, and its total costs are ct_i.

Profits are then equal to

$$\pi_i = g(p_i, t_i, t_i^2, t_j, m_i) - ct_i \quad (1.5)$$

Each team solves for profit maximization by equating the marginal revenue of talent to the marginal cost of talent, where talent is the team's primary decision variable.

A crucial assumption in this model is that attendance increases with wins but at a diminishing rate:

$$\partial A_i/\partial w_i > 0;\ \partial^2 A_i/\partial w_i^2 < 0 \quad (1.6)$$

This key assumption delivers the much-analysed *uncertainty of outcome hypothesis* (UOH) emanating from Rottenberg (1956). Fans enjoy their team winning but extra wins offer smaller increments to fan enjoyment. Translated into the attendance demand function (1.1), extra wins for a team attract more fans but with diminishing returns. With this assumption in place, the second-order conditions for a profit maximum are fulfilled. Conversely, if the assumption does not hold via empirical testing, the second-order conditions are violated and the model structure is undermined.

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A reduced version of the profit-maximizing model is the two-team model of sports leagues, set out in Fort and Quirk (1995) and popularized in many sports economics textbooks. In this version team *x* is a large market team and team *y* is a small market team. Each team has a marginal revenue curve that is downward-sloping against talent. Equilibrium is where the marginal revenues of each team are equal to each other and to the marginal cost of talent. This model generates the *invariance proposition*, first shown by Rottenberg (1956) in advance of the famous Coase theorem on property rights. Revenue sharing between teams shifts marginal revenue curves for each team downwards in equal proportions. The allocation of talent will then be unaffected. However, the strong assumptions required for this result to hold include competitive product and labour markets, and zero transactions costs.

2.2.2 The win-maximizing model of team sports leagues

Peter Sloane's seminal article (Sloane 1971) addressed the peculiarities of European sports leagues, especially football, and proposed a utility-maximizing approach as an alternative to the profit-maximizing model. Both wins and profits appear in Sloane's general function for utility of team owners. In a formal development of Sloane's contribution, Kesenne (1996, 2014) has articulated a parsimonious win-maximizing model as

$$\text{Max } w_i \text{ subject to } g(p_i, t_i, t_j, m_i) = ct_i \tag{1.7}$$

Hence, teams maximize wins subject to a balanced budget condition. Note that the assumption of $\partial^2 A_i/\partial w_i^2 < 0$ is not required.

In the reduced two-team model, equilibrium is where average revenues for each team are equalized, not marginal revenues. In equilibrium, average revenue is defined as revenue per unit of talent equals unit cost of talent, *c*. Revenue sharing necessarily improves competitive balance, as does a formal, enforceable salary cap. For a fixed supply of talent, revenue sharing transfers resources from the large team to the small team; talent is reallocated until average revenues are again equal for each team. The average revenue curve of the large market team shifts down against talent while the average revenue curve of the small market team shifts up. The shifts are not equi-proportionate, and the unit cost of talent, essentially player salary, will increase (Kesenne 2014).

A payroll cap on teams, *cap*, can be modelled as $c \leq cap/ct_i$ for all teams *i*. Then the average revenue curves for each team are replaced by rectangular hyperbolae. In the win-maximizing case, talent is reallocated from the large team to the small team, since each must respect the balanced budget condition. Competitive balance improves and the unit cost of talent must fall. These results are similar to the profit-maximizing case (Kesenne 2000).

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However, the motivations for salary cap interventions are different. For North American profit-orientated sports leagues, the objective of a hard, uniform payroll cap may well be to redistribute surpluses from payrolls (players) to profits (team owners). In European sports leagues, salary cap interventions are often expressed as requirements for financial discipline – i.e. enforcement of the balanced budget condition underpinning the win maximization model. This in turn begs a deeper question: why should team owners voluntarily adhere to the break-even condition proposed in the win-maximizing model? The answer to this question surely lies within a fuller consideration of incentives facing sports team decision-makers.

2.2.3 Economic competition in sports

Orthodox microeconomic theory in terms of competitive markets predicts that, where there are excess profits, these will be competed away by new entrants. The peculiarities of the sports industry are such that this principle has to be modified. Entry into North American sports leagues, broadly characterized as comprising profit-maximizing teams, is strictly limited. Leagues operate as cartels, exempt from standard antitrust policies, and entry is rarely permitted. When entrants are allowed, the new owners must pay a substantial upfront fee to existing owners to compensate for the dilution of profits. Hence, the largest size of a North American sports league is 32 for the National Football League (NFL). Excess profits (economic rents) are sustained under such structures.

Small league sizes without relegation, together with the threat of franchise relocation, offer rent-seeking opportunities for North American sports team owners. Specifically, team owners extract large subsidies from local governments to finance new and more profitable stadia for their teams. The threat to the local community is that the team will relocate if it does not receive the subsidy; with only 27 cities occupied by Major League Baseball teams, this threat tends to be credible (Feng & Humphreys 2018). This notion of rent-seeking extends to the construction of stadium facilities for major international sports tournaments, such as the Olympic Games and the FIFA (Fédération Internationale de Football Association) World Cup.

In sports labour markets, team roster sizes tend to be largely fixed, either by league rules, as in North America, or by practice, as in Europe. The conventional notion of a labour demand curve is irrelevant, as teams try to adjust the quality of talent rather than the number of players. North American sports leagues have considerable restrictions on player mobility, including the college draft (conscription) and long-term rookie contracts, in which the time taken to achieve free agency is long (four years in the NFL and six years in the MLB). Taken together with the small numbers of teams in major leagues, rookie players are subject to

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monopsony exploitation while only free agents get pay close to marginal revenue product (MRP) (Krautmann, von Allmen & Berri 2009; Solow & Krautmann 2011).

In European football, freedom of movement within the European Union, enforced in sports since the Bosman ruling of 1995, might be taken to imply a competitive labour markets for professional players. However, players might exhibit preferences for employment in domestic leagues, effectively reducing outside options and conferring bargaining power to team owners (Bryson, Rossi & Simmons 2014). Sports players tend to have specific talents and attributes that are demanded by teams, regardless of club objectives. This gives rise to job match surpluses as differences exist between expected returns and returns from next best alternatives within thin markets (Leeds & Kowalewski 2001). Players (via agents) and teams bargain over player salaries, with each party considering the outside options of themselves and the other party (Krautmann & Solow 2009). This is essentially rent-sharing, which becomes most pronounced when exogenous (to player) injections of finance become available, as, for example, by owner investments, sponsorships and new broadcast rights sales. The integration of the concepts of bargaining and rent-sharing between players and team owners into sports league structures is a question in need of further theoretical and empirical research.

2.2.4 Behavioural sports economics

The interaction of insights from psychology with theoretical and empirical rigour from economics has generated growth in behavioural economics. The key concept of moral hazard, or hidden actions, which was already well established in microeconomics, has many sporting applications rooted in behavioural economics.

Continuing with the win-maximizing model of a sports league, Egon Franck (2018) has argued that teams have incentives to violate the break-even condition. This is because teams with substantial deficits and debt will expect to be "bailed out", either by rich "sugar daddy" owners with deep pockets or by government (national or local). Teams then have a *soft budget constraint* and overbid for scarce player talent. In the case of European football leagues, this takes the form of high levels of player salary and high transfer fees, since player registrations are traded for cash and the transfer fee is compensation to a selling team for the loss of player services. The soft budget constraint in turn leads to a moral hazard problem, as executives in charge of player contracts, typically a director of football, will be incentivized to overbid for player talent so as to deliver wins or league ranking objectives, safe in the knowledge that financial implications are covered by owners or external bodies. This line of argument was the economic motivation behind the 2011 Financial Fair Play policy by UEFA (Union of European Football Associations) for European football teams aspiring to play in

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Champions' League and Europa League competitions. UEFA wanted to restore incentives for teams to break even and so implemented a policy of maximum allowable losses over three-year periods deliberately designed to meet financial solvency. The Financial Fair Play policy is not a salary cap and is not designed to address competitive balance problems.

Another example of moral hazard in sports is the reverse-order draft process in North American sports leagues, which are closed, without relegation. Teams may be awarded draft picks for the best talent from college sports based on previous season standings. The teams performing worse get (in principle) the best draft picks. This policy is designed to help improve competitive balance. Leaving aside the problem that order of draft picks is not a good predictor of future player productivity (Berri & Simmons 2011; Massey & Thaler 2013), this system raises a moral hazard question. Perhaps teams might deliberately engineer losses, for example, by selecting weaker teams, especially if they are out of play-off contention, to receive the best draft picks for the next season? Taylor and Trogdon (2002) found evidence of "tanking to win" in their study of the NBA (National Basketball Association) draft in the 1980s. The draft policy was changed in 1990 to a lottery format.

Behavioural economics has expanded upon simple incentive-based concepts. Kahneman and Tversky's (1979) prospect theory has generated a host of sporting applications. This theory posits a reference point for individuals' utility and evaluates gains and losses around this point. Expected utility is concave in expected gains while convex in expected losses. The absolute marginal utility of expected loss exceeds marginal utility of expected gain, termed "loss aversion". Coates, Humphreys and Zhou (2014) applied this concept to rationalize their empirical finding that $\partial^2 A_i/\partial ph_i^2 > 0$, where ph is probability of home win in a regression model of MLB game attendances. This finding has been corroborated in studies of other leagues (e.g. Martins & Cró 2018) and contradicts the uncertainty of outcome hypothesis. The idea is that a large number of sports fans dislike a high probability of their team losing and prefer to stay away from games. Conversely, they are more likely to attend when there is a high probability that their team will win. Attendance demand will then exhibit a U-shape against the probability of a home win and not an inverse U-shape, as implied by the UOH.

Prospect theory has a further component: probability distortions, or the tendency of agents to overweight low-probability outcomes. This notion has been used to explain gambling behaviour, including the fondness of many punters for bets on longshots. Behavioural sports economics reveals a host of potential biases in sports stakeholder actions. These include the favourite–longshot bias; hot hand fallacy; overconfidence bias and sentiment bias in sports betting; a winner's curse in auction bidding for broadcast rights (Butler & Massey 2019) and in bidding for free agent players (Burger & Walters 2008); outcome bias, whereby coaches increase their strategy revision excessively following team losses (Lefgren, Platt & Price 2014); excessive rewards for lucky successes (Gauriot & Page 2019); and present bias, when individuals buy and then do not use gym membership (DellaVigna & Malmendier 2006).

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Behavioural sports economics can be usefully applied to many topics, including habit persistence in attendance demand, choking under pressure in contests (Cao, Price & Stone 2011; Böheim, Grübl & Lackner 2019) and social pressure on match officials (Dohmen & Sauermann 2016).

2.3 EMPIRICAL METHODS

Empirical analyses of sports apply both primary and secondary data. Primary data sources are, typically, survey questionnaires and are widely used in studies of individual sports participation, but fan surveys are also used in studies of audience demand and behaviour. Secondary data sources are used in studies of team sports, and these sources are normally publicly available via internet websites, such as Rodney Fort's Sport Business Data for North American sports and www.whoscored.com and www.transfermarkt.de for soccer. Popular empirical methods are variants of ordinary least squares (OLS) with panel data, whereby the researcher has data on groups of subjects through time. Recently there has been a growth in interest by sports economists in natural experiments whereby one group receives some treatment – e.g. a rule change or change in local taxation – and another comparable group does not receive the treatment and forms a control group.

2.3.1 Contingent valuation method

CVM is an important approach for the evaluation of public interventions towards sports. For a comprehensive review, see Orlowski and Wicker (2019). An early example, Johnson, Groothuis and Whitehead (2001), shows how this method proceeds. The authors evaluated fan willingness to pay for National Hockey League (NHL) franchise Pittsburgh Penguins to stay in Pittsburgh. A self-designed questionnaire was sent out to Pittsburgh residents. This featured two scenarios. The first was a statement that Pittsburgh Penguins was likely to relocate away from Pittsburgh. The second scenario proposed public ownership of the franchise at cost to taxpayers with four tax values randomly assigned across respondents (the payment vehicle). The survey also contained questions on income, fan affiliation to the team and general questions about the importance of the team to respondents, designed to capture public good attributes. The survey results showed how much Pittsburgh residents were willing to pay to keep the NHL franchise in the city, albeit from 226 respondents argued to be representative of the local population. The authors computed use value as mean willingness to pay (WTP) from a tobit regression model minus non-use value as WTP for public good consumption of having the franchise in the city. Extrapolating from sample to population, the

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authors found positive willingness to pay in extra taxes for retaining the team in the city. However, this willingness to pay was lower than the expected cost of the public subsidy that would be demanded by team owners not to relocate.

Since Johnson, Groothuis and Whitehead (2001), CVM studies have expanded in number and scope to include, inter alia, willingness to pay for: Olympic medal success (Wicker *et al.* 2012), keeping an NFL team in a city (Johnson, Mondello & Whitehead 2007), saving a bankrupt English football club from insolvency (Barlow & Forrest 2015) and membership of non-profit sports clubs (Swierzy, Wicker & Breuer 2018). CVM is clearly a versatile and useful empirical stated-preference method for sports policy evaluation.

2.3.2 Ordinary least squares regression and extensions

Most studies of attendance demand and broadcast audience demand consider revealed rather than stated preferences by tracking published secondary data on audiences. Such studies have typically used ordinary least squares estimation. These estimations quickly run into problems. For example, sell-out crowds generate a censoring problem in attendance demand studies that require tobit estimation (Buraimo & Simmons 2008). Attendance demand studies routinely use team fixed effects to control for lack of price information and, more generally, unobserved heterogeneity in match-level panel data (Martins & Cró 2018). Distinguishing impacts of time-varying and time-invariant covariates on attendance demand in panel data is rarer, although see Buraimo, Forrest and Simmons (2009) for application of a Hausman–Taylor random effects estimator to perform this task.

OLS estimations of player and coach salary models are also flawed. Salary distributions in professional sports are not log-normal and are highly skewed, even more so than in standard occupations. This can be dealt with by quantile regression, which is an alternative estimator to OLS (Leeds 2014). Quantile regression estimates coefficients of covariates throughout the distribution of the dependent variable using least absolute deviation from the mean. This method is useful for the evaluation of superstar effects on player salaries (Bryson, Rossi & Simmons 2014; Carrieri, Principe & Raitano 2018) and the effects of discrimination on player salaries when evaluation at the mean is not the most interesting case (Burnett & Van Scyoc 2015; Holmes 2011; Keefer 2013; Vincent & Eastman 2009).

OLS estimations are potentially subject to endogeneity concerns. Endogeneity of supposedly independent variables can arise through omitted variables, reverse causality and measurement error. Each of these is a threat to econometric identification, as the OLS coefficients may be biased. Upward bias in estimated OLS coefficients can occur if relevant variables are omitted or there is reverse causality. Measurement error in the dependent variable can lead to bias in either direction. A standard resolution of endogeneity concerns is

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to find instrumental variables (IVs) that are correlated with the endogenous explanatory variable but uncorrelated with the equation error term. This turns out to be a difficult task in sports economics, and the literature on sports participation illustrates the challenges for researchers.

For example, Brechot, Nüesch and Franck (2017) model the impacts of sports participation on health outcomes in Switzerland using the Swiss Household Panel. Health outcomes are measured as overweight, sleeping problems, headaches, back problems and fatigue. OLS estimates show significant negative impacts of sports participation, defined as "doing sports at least once per week", on each of the outcomes and a positive, significant effect on a general measure of health well-being. The sports participation measure is subject to measurement error and the OLS equation has omitted variables even with control variables included.

Brechot, Nüesch and Franck (2017) propose the number of sports facilities within 10 km (6 miles) of the respondent's residence as an instrument for sports participation. Huang and Humphreys (2012) and Ruseski *et al.* (2014) used closeness to sports facilities in their IV estimations of the effects of physical activity on well-being. Brechot, Nüesch and Franck's instrument predicts sports participation very well and standard diagnostic tests in IV estimation all pass. But IV estimates show insignificant (zero) effects of sports participation on all measured health outcomes, which appears implausible, casting doubt on both data and choice of instrument. In an influential study, Lechner (2009) offers an alternative approach to IV in his estimation of effects of sports participation on health and labour market outcomes. He uses the German Socio-Economic Panel 1984–2006 to apply a semi-parametric matching estimator with a synthetic control group, with matching on observable variables. Using this estimator, Lechner finds statistically and economically significant effects of sports activity on earnings, wages, health and subjective well-being.

2.3.3 Natural experiments in sports

Kahn (2000) famously stated that the sports industry could effectively be used as a "laboratory" for empirical research given the huge availability of data, often publicly available at low cost. Notable exceptions to this remain broadcast audience viewing data and sports analytics data, which tend to be either proprietary or costly to acquire. Nevertheless, Kahn's principle appears to hold for sports economics. In science and medical laboratories, experiments are performed with strictly defined and monitored treatment and control groups assigned randomly. In economics, empirical studies with random allocation of subjects are very rare. But less well-defined quasi-natural experiments can still be modelled in economics if treatment and control groups are well designed and particular conditions hold, such as

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common trends of groups before intervention. Unfortunately, the professional sports sector has the problem for investigators that rule changes tend to be universal, with all stakeholders becoming impacted at the same time – e.g. if the rules of association football change or there is a new collective bargaining agreement in a North American sports league.

Despite the commonality of institutional changes in sports, natural experiment studies have found their way into sports economics. Performed appropriately, such studies have the capability to overcome the lack of econometric identification and provide reasonably precise estimates of treatment group responses, especially local average treatment effects, to exogenous interventions. The basics of the method are shown in Table 2.1, using descriptive data from Buraimo, Migali and Simmons (2016). The treatment group is clubs that were punished after the Calciopoli scandal of 2006, relating to the manipulation of matchday football referees in Italy's Serie A. The control group is all clubs not punished. We take the difference in mean seasonal attendance between treatment and control groups before the punishment. Then we take the difference in mean attendance between groups after the punishment. Then we compute the net difference before and after punishment, which is a reduction of 5,803 fans.

Table 2.1 Descriptive seasonal attendances in Italy Serie A (Buraimo, Migali & Simmons 2016)

	Treatment group	*Control group*	*Difference*
Pre-punishment 2002/03–2005/06	37,719	22,687	15,032
Post-punishment 2007/08–2010/11	31,182	21,953	9,229
			5,803

In the paper this descriptive result is extended into a more formal matchday attendance model, with a full set of control variables. To simplify, the difference-in-difference impact of event X on log attendances (log A_{it}) is given by

$$\text{Log } A_{it} = \beta_0 + \beta_1 \text{Treatment}_{it} + \beta_2 \text{Post-Event}_{it} + \beta_3 \text{Treatment*Post-Event} + \text{control variables} + \text{fixed effects} + \text{error term} \quad (1.8)$$

Here, Treatment is a dummy variable coded one for teams that were punished, Post-Event is a dummy variable coded one for each season after the event or intervention and Treatment*Post-Event is the focal difference-in-difference term with β_3 as the key parameter of interest. Table 2.2 summarizes a selection of difference-in-difference studies in sports economics. The diversity of these studies is impressive, and more will surely follow.

Table 2.2 Selected difference-in-difference studies in sports economics

Study	*Treatment group*	*Control group*	*Key result*

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Bryson, Buraimo and Simmons (2011)	English Premier League (EPL) referees on salaried contracts	English Championship referees on payment by match fee	Salaried referees delivered better performances via fewer yellow cards.
Buraimo, Migali and Simmons (2016)	Four Italy Serie A clubs convicted of referee manipulation	All other Serie A clubs	Punished clubs had 16% lower attendances than unpunished clubs.
Buraimo, Migali and Simmons (2021)	English Football League clubs in localities with high growth in unemployment during recession	English Football League clubs in localities with low growth in unemployment during recession	Treated clubs in tiers 3 and 4 had 10.5% drop in attendances attributable to recession; treated clubs in tiers 2, 3 and 4 had 9.4% drop in attendances.
Cisyk (2020)	Major League Baseball teams with players suspended for performance-enhancing drug (PED) violations	All other Major League Baseball teams	An immediate 9.3% reduction in TV audience for treatment group but effect declined to zero over 33 game broadcasts.
Cisyk and Courty (2017)	Major League Baseball teams with players suspended for PED violations	All other Major League Baseball teams	An immediate 8% reduction in home team attendance for treatment group, which declined to zero by 15 days.
Feddersen and Maennig (2013)	US counties in Georgia that hosted Olympic Games events in Atlanta 1996 or were close to host counties	All other Georgia counties	Zero employment effects for venue or near-venue counties.
Harger, Humphreys and Ross (2016)	Business openings within 5 miles of new stadia in 12 US cities	Business openings more than 5 miles from new stadia but in same metropolitan area	No effect of new stadia on business openings.
Hogan and Massey (2018)	English Rugby Union championship teams, 1987/88 to 2015/16	French Rugby Union championship teams, 1987/88 to 2015/16	Competitive balance improved in English Rugby Union relative to French Rugby Union due to binding salary cap in England.
Hotchkiss, Moore and Zobay (2003)	US counties in Georgia that hosted Olympic Games events in Atlanta 1996 or were close to host counties	All other Georgia counties	Significant positive employment effects for venue or near-venue counties.
Izquierdo Sanchez, Elliott and Simmons (2016)	Cinema admissions for films released in England and Spain during World Cup and European championships while each team was in the tournament	Cinema admissions for films released in same period in Finland and Belgium as non-qualifiers for World Cup and European championships	Large and robust negative effect of major football tournaments on cinema attendances in treatment group.
Pyun and Hall (2019)	Pontiac, Michigan, as former host of Detroit Lions NFL team	13 areas within Detroit, Michigan	Weak evidence of decreases in larceny and vandalism in Pontiac after Detroit Lions relocated to downtown Detroit; no effect on assaults.
Rickman and	English Premier League referees	English Championship referees	Referee bias in form of added time

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Witt (2008)	on salaried contracts	on payment by match fee	in close games was reduced for referees on salaried contracts.

2.4 CONCLUSION

This chapter explores a selection of the theories and methods that will appear frequently in the sports economics literature. This is not to say that other methods and theories do not exist – they do – but, rather, that what appears here are among the most popular aspects of the subject today and will emerge in the various sections and chapters that follow throughout this collection of chapters. Like all fields of study, sports economics will no doubt extend and evolve, and new methods of analysis will emerge. This will be driven by what happens in the general field of economics. One might expect the use of big and high-frequency data to become prevalent in the empirical analysis, with the modelling of such resources also likely to become more important. The increased application of behavioural economics to sport will gain pace in the years ahead if the last number of years proves to be a good indicator of what will follow.

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